

1. A method of controlling a CMP (Chemical Mechanical Polishing) process for a semiconductor substrate being polished by a rotating polishing pad, the method comprising:

5        detecting and mapping in two dimensions the temperature of the rotating polishing pad during the CMP process;

         storing in computer memory the two dimensional temperature map of the rotating polishing pad  
10        temperature versus real polishing time; and

         controlling process parameters of the CMP process using the two dimensional temperature maps of the rotating polishing pad temperature versus real polishing time, as stored in computer memory.

15

2. The method of claim 1, wherein the temperature of the rotating polishing pad is detected with an infrared camera.

20        3. The method of claim 2, wherein said infrared camera records a two dimensional thermal image of a portion of the rotating polishing pad.

         4. The method of claim 1, wherein the mapping in  
25        two dimensions of the rotating polishing pad temperature includes regions of the rotating polishing pad which are not in contact with the semiconductor

substrate during the CMP process and regions of the rotating polishing pad which are abrading the semiconductor substrate during the CMP process.

5           5. The method of claim 1, wherein the uniformity of removal of material by the CMP process is controlled by detecting the uniformity of the polishing pad temperature and adjusting polishing process parameters to improve the uniformity of the polishing pad  
10           temperature during the polishing process.

          6. The method of claim 1, wherein endpoint for removal of a material is established by detecting a change of temperature of the polishing pad versus  
15           polishing time.

          7. A method of controlling the uniformity of removal of material in a CMP (Chemical Mechanical Polishing) process for a semiconductor substrate being  
20           polished by a rotating polishing pad, the method comprising:

          detecting and mapping in two dimensions the temperature of the rotating polishing pad during the CMP process;

25           storing in computer memory the two dimensional temperature map of the rotating polishing pad temperature versus real polishing time; and

adjusting polishing process parameters of the CMP process to maximize the uniformity of the two dimensional temperature maps of the rotating polishing pad temperature versus real polishing time.

5

8. The method of claim 7, wherein the temperature of the rotating polishing pad is detected with an infrared camera.

10 9. The method of claim 8, wherein said infrared camera records a two dimensional thermal image of a portion of the rotating polishing pad.

15 10. The method of claim 7, wherein the mapping in two dimensions of the rotating polishing pad temperatures includes regions of the rotating polishing pad which are not in contact with the semiconductor substrate during the CMP process and regions of the rotating polishing pad which are abrading the semiconductor substrate during the CMP process.

20

11. A method of detecting endpoint for removal of material in a CMP (Chemical Mechanical Polishing) process for a semiconductor substrate being polished by  
25 a rotating polishing pad, the method comprising:

detecting and mapping in two dimensions the temperature of the rotating polishing pad during the CMP process;

storing in computer memory the two dimensional temperature map of the rotating polishing pad  
5 temperature versus real polishing time; and

detecting endpoint for removal of material when the temperature of the polishing pad changes.

10 12. The method of claim 11, wherein the temperature of the rotating polishing pad is detected with an infrared camera.

13. The method of claim 12, wherein said infrared  
15 camera records a two dimensional thermal image of a portion of the rotating polishing pad.

14. The method of claim 11, wherein the mapping in two dimensions of the rotating polishing pad temperatures includes regions of the rotating polishing pad  
20 which are not in contact with the semiconductor substrate during the CMP process and regions of the rotating polishing pad which are abrading the semiconductor substrate during the CMP process.

25

15. The method of claim 11, wherein the temperature of the rotating polishing pad decreases due to removal

of a hard, difficult to polish material followed by contact of the rotating polishing pad with a soft, easy to polish material.

- 5           16. The method of claim 11, wherein the temperature of the rotating polishing pad increases due to removal of a soft, easy to polish material followed by contact of the rotating polishing pad with a hard, difficult to polish material.

10